125. Deep-Water Corals from the Riukiu Limestone of Kikai-jima, Riukiu Islands.

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In a recent visit to Kikai-jima (Riukiu Islands; Ôshima subgroup), Mr. S. Hanzawa[1] of our Institute collected a large quantity of well preserved fossils from an incoherent calcarenite of the Riukiu Limestone on the limestone plateau above Kamikatetsu. Of the fossils, most dominant are foraminifera[2] and bryozoa, followed by corals and mollusca, while brachiopods are considerably less numerous, though fairly common.[3]

The corals in this collection amount to more than 1,500 in the number of individuals and comprise 27 species in 21 genera and subgenera belonging to 5 families; most of them are deep-water forms which are solitary, non-branching and either grown free or attaching to small foreign bodies by the narrow proximal end. There are in addition a few small indeterminable fragments of colonial reef-corals, which are quite negligible in comparison with the overwhelming number of deep-water forms. Annexed is the list of the fossil corals, with the number of specimens in bracket.

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1) His geological study of the Riukiu Islands in 1931 and 1932 was performed in support of a grant of the Saitô Gratitude Foundation. As to the geology of Kikai-jima, we are informed by him as follows. The Riukiu Limestone, at most 60 m. thick, of the limestone plateau, 203 m. at the heighest point, is unconformably underlain by the Neogene Shimajiri Group mostly composed of bluish gray *Globigerina*-mud with occasional intercation of massive unfossiliferous sandstone. The Riukiu Limestone is a complex of limestone locally very variable in texture and fossil content; reef corals are common and wide spread; in the western part of the island there prevails loose calarenite rich in minute foraminifera and in its central part accumulations of the large sized tests of *Operculina bartschi* Cushman var. *punctata* Yabe and Hanzawa. The unconsolidated calcarenite, very rich in deep-water corals dealt with in this article and other fossils, is exposed at a cliff of the plateau limestone 500 m. north of Kamikatetsu in the southwestern part of the island. The limestone plateau is terraced at several heights, the lowest one being the post-Pleistocene raised coral reef which surrounds the plateau in a broad belt.

2) Larger forms are, according to Hanzawa, *Cycloclypeus gümbelianus-carpenteri* Brady, *Baculogypsinoides spinosus* Yabe and Hanzawa, *Heterostegina depressa* d'Orb., *Amphistegina radiata* (F. & M.), *Sporadotrema cylindricum* (Carter), *Planorbulinella larvata* (Parker & Jones), *Operculina complanata* (Dfr.), *Polytrema corallina* Risso and *Marginopora vertebralis* Gaimard & Quoy.

3) Most of the brachiopods belong to *Pictothyris pictus* (Dillwyn ?) Thomson. H. Yabe: Brachiopods of the Genus *Pictothyris* Thomson, 1927. Sci. Rep. Tôhoku Imp. Univ., 2nd Ser. (Geol.), Vol. XV, No. 3, 1932.

Turbinolidae

Caryophyllia compressa n. sp. (170), **C. paucipaliata* n. sp. (230), **Trochocyathus* (*Thecocyathus*) *hanzawai* n. sp. (320), *T.* (*Tropidocyathus*) *intermedius* n. sp. (3), *Citharocyathus venustus* Alcock (30), *Deltocyathus orientalis* Duncan (15), **Peponocyathus orientalis* n. sp. (52), *Discotrochus dentatus* Alcock (2), *Conotrochus elongatus* n. sp. (5), *Heterocyathus aequicostatus* M. Edw. & H. (150), *Goniocyathus pacificus* Yabe & Eguchi (3), **Fragilocyathus?* sp. (35).

Flabellidae

Flabellum rubrum Quoy & Gaimard (100), *F. transversale* Moselev (80), *F. stokesi* M. Edw. & H. (50), *F. distinctum* M. Edw. & H. (4).

Astraeidae

Parasmilia fecunda Pourtalès (1), *Antillia duncani* Yabe & Sugiyama (18).

Fungidae

**Fungia* sp. (26), **Bathyactis kikaiensis* n. sp. (110).

Eupsammidae

Stephanophyllia (*Letepsammia*) *formossisima* Moseley (110), **S.* (*L.*) *japonica* n. sp. (12), *S. fungulus* Alcock (36), **Heteropsammia ovalis* Semper var. *japonica* n. var. (100), *Balanophyllia fistula* Alcock (30), *B.* sp. (10), *Endopachys japonicum* Yabe & Eguchi (120).

The fossil coral fauna has 19 species in 15 genera and subgenera in common with the recent deep-water coral fauna of the Japanese seas[1] and only 8 species of the former marked with an asterisk in the above list are not yet known as living. With the exception of *Peponocyathus* all the genera of the fossil fauna are represented in the living one; *Peponocyathus* is a genus of corals hitherto known only from the Atlantic water and *P. orientalis* is the first Pacific species to be recorded and at the same time the first species found as fossil. On the other hand, *Fragilocyathus* and *Goniocyathus* are two genera apparently proper to the Japanese seas, being not yet found elsewhere.

The following 6 species are living and known at present only from the Japanese seas (endemic?): *Caryophyllia compressa, Trochocyathus* (*Tropidocyathus*) *intermedius, Conotrochus elongatus, Goniocyathus pacificus, Antillia duncani, Endopachys japonicum.*

The following 9 species have a wider geographical distribution extending from the Japanese seas to the Philippines or to more southern seas: *Citharocyathus venustus, Discotrochus dentatus, Heterocyathus aequicostatus, Flabellum rubrum, F. transversale, F. stokesi, Stephanophyllia fungulus, S. formossisima, Balanophyllia fistula.*

Three other species are cosmopolitan and 1 is closely allied to a cosmopolitan species: *Deltocyathus orientalis, Parasmilia fecunda, Flabellum distinctum, Balanophyllia* sp. aff. *B. italica* (Mich.).

The approximate depth of water in which the fossiliferous calcarenite has come to accumulation can be infered on the data lately obtained by the Surveying Ship Sôyô-maru of the Imperial Fisheries Institute

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1) H. Yabe and M. Eguchi: A Study of the Recent Deep-Water Coral Fauna of Japan. Proc. **7** (1932), 8.

relating to the bathymetrical range of the deep-water corals now living in the Japanese seas. From the materials at hand, we learn that *Caryophyllia compressa*, *Conotrochus elongatus*, *Goniocyathus pacificus*, *Discotrochus dentatus* and *Flabellum stokesii* have a range extending from 100 m. to 400 m. (or even down to 600 m.), *Endopachys japonicum*, *Deltocyathus orientalis* and *Flabellum distinctum* from 40 m. to 600 m., *Trochocyathus intermedius* from 100 m. to 200 m., *Citharocyathus venustus* from 150 m. to 300 m., *Flabellum rubrum* and *F. transversale* from 50 m. to 100 m., and *Stephanophyllia fungulus* from 100 m. to 150 m. Furthermore, *Antillia* and *Fungia* are essentially shoal-water forms and these corals in their normal growth do not seem to be extended in their range down to much below 70 m.; *Heteropsammia nipponica* n. sp. allied to *Heteropsammia ovalis* var. *japonica* is living in a depth of 40–50 m. Consequently the fossil deep-water coral fauna under consideration may represent a life on a part of the continental shelf certainly 50–200 m., or more narrowly limited 100± m. deep.

The precise age-determination of the Riukiu Limestone, either the youngest Tertiary or Pleistocene?, can not be approached from the present study of its deep-water coral fauna; but in fact the fauna has 27 species in total with 8 species (30%) not yet known as living.

The most successful stations for corals of the Sôyô-maru are No. 220, west of the Cape Moroto, Tosa, 234 m. deep, and No. 293, off the west coast of Tanega-shima, 203 m. deep. She obtained in one dredge haul, deep-water corals amounting to 13 species in 8 genera and to 11 species in 9 genera from the former and latter locality respectively; the fossil locality of Kikai-jima was ceratinly a ground in the past exceedingly richer in varieties of corals than any of the Sôyô-maru stations.

A brief account of the first Pacific species of *Peponocyathus* is as follows:

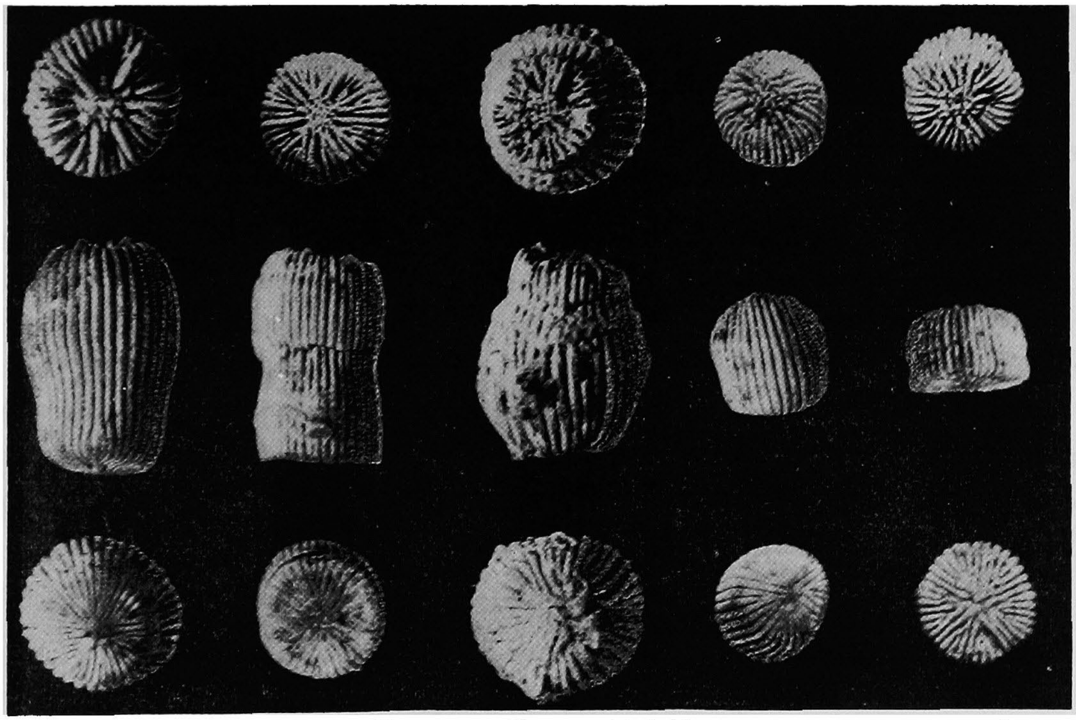
Peponocyathus orientalis Yabe and Eguchi, nov.

Corallum small, free, barrel-shaped, truncated at both ends and usually a little swollen at the middle of the lateral surface; sometimes more or less irregularly cylindrical with slightly expanded base; often constricted transversely; lateral surface occasionally covered by a thin epitheca developed zonally. Base nearly flat or rather slightly convex, and mamillated at the center. Costae well developed, equal, continuous with septa, furnished with numerous fine spines or acute granules on their lateral surfaces as well as on the outer edge, which thereby exhibits a serrated aspect; interspaces deep and narrow, thus rendering wall-proper quite invisible from the outside; all the costae, except the primary ones, arranged in 6 deltoid groups with their apices, extending to the central mamilla and separate from the primary costae throughout their length until they reach the central mamilla. Calice very shallow, entirely filled by septa, pali and columella. Septa 36–48, in 4 cycles in hexameral arrangement, the fourth cycle sometimes incomplete; subequal in thickness, reducing length and height successively in younger cycles; 6 septa of the first cycle most exsert, these and 6 septa of the next cycle reach columella, the latter forming with the septa of the younger cycles 6 deltoid groups; all the septa finely spinous or acutely granulated on the lateral surfaces. Pali well developed, those in front of the septa of the second cycle being the largest of all. Columella broad, spongy, papillated above and indistinguishable from the pali of the innermost crown.

Peponocyathus is very similar to *Deltocyathus* except for the cylindrical growth of its corallum, which often exhibits the sign of regeneration or rejuvenation by transverse constrictions. *Leptocyathus* is another allied genus, but it differs from *Peponocyathus* by having habitually distinct pali in front of septa of every cycles.

Peponocyathus has only two species from the Atlantic, *P. variabilis* Gravier and *P. stimpsoni* (Pourtalès); of the two, the former closely resembles our species, but its corallum even in the adult is smaller and has only three cycles of septa.

Locality and geological age: the limestone plateau above Kamikatetsu, Kikai-jima. The Riukiu Limestone; the latest Tertiary according to Yabe and Hanzawa. Reg. No. 43423.



Peponocyathus orientalis. ×3